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Development of Super Deformed Digital Manga Comic Media Using Microsoft Paint to Improve Learning Outcomes and Learning Motivation of Junior High School Students on the Earth and Solar System Material

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ABSTRACT

Purpose of the study: Learning media used in teaching must increase student interest and motivation. An example is comics. This research on the development of digital super deformed manga comics has several objectives: to assess the media's validity, to test its practicality, and to test its effectiveness.

Methodology: The research used is a type of Research and Development (R&D) research that provides validation of the developed product to be used in the learning process. The development model used in this study is the 4D model, which consists of 4 stages: defining (define), planning (design), developing (development), and disseminating (disseminate).

Main Findings: The study achieved a validity level of 91.5% and was deemed valid. The results of the practicality of comic media in increasing learning motivation were 91.875% in the first school, 90.625% in the second school, and 92.5% in the third school. Meanwhile, the N-Gain scores indicating an increase in learning outcomes were 0.81 in the first school, 0.63 in the second school, and 0.69 in the third school.

Novelty/Originality of this study: A super deformed digital manga comic was created using Microsoft Paint. This super deformed digital manga comic, in addition to using a chibi or super-deformed style, also imitates the drawing style of Masashi Kishimoto, the creator and writer of the Naruto series. This novel comic medium has successfully improved student learning outcomes and motivation.

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1. INTRODUCTION

Science Education is a science that studies and understands the events that occur and the facts that exist in the universe in a systematic way, starting from small things like cells to astronomical levels such as stars and other celestial bodies. Several experts and researchers previously argued that science education is a creative process in searching for and studying various causes and effects of events that occur in the entire universe and its contents, as well as the phenomena that occur in it which are developed by experts in a series of long chemical processes that are carried out very carefully and very thoroughly [1]. Science is the school subject with the lowest ranking on national exams for both public and Islamic schools. Problems also arise at the school level,

where student mastery of science remains very low at all levels of junior high school and Islamic junior high school. To address the aforementioned issues and obstacles, teachers must take the initiative to equip themselves with specific strategies for implementing learning processes that are adapted to the changing times. Therefore, it is hoped that the use of technology will improve students' collaborative skills. This collaborative activity needs to be enhanced to create appropriate science learning [2].

As educators, teachers can use teaching materials to help explain and convey learning material in class. These teaching materials can also serve as a guide for students in learning and understanding the material explained in school [3]. The Ministry of National Education defines teaching materials as information in the form of tools or texts that can be used by teachers or instructors to plan and review the implementation of learning [4]. The learning process in the classroom must foster a general pattern of learning behavior that achieves the desired learning objectives and competencies. Furthermore, the learning process is expected to achieve optimal learning outcomes that meet the needs of the students themselves. The learning process must be innovative and enjoyable, resulting in improved student achievement and improved learning outcomes [5].

Current technological developments require teachers, as professional educators, to be able to prepare learning media. Technological advancements can improve the quality of learning media in the form of digital teaching materials, resumes, or documents in digital format, which have numerous benefits for learning [6]. Media can be used effectively in formal situations where students work independently or teachers work with other groups of students [7]. When teachers use learning media, it can increase student interest in learning [8]. Furthermore, research shows that the use of technology in the classroom can significantly improve student learning outcomes. This will make it easier for students to understand the concepts being taught [9]. The use of learning media can certainly foster interest in students [10]. The approach of utilizing digital technology as a learning medium has a better and more effective impact than others [11] [12].

The validity of an instrument or measuring tool is related to the accuracy of the measurement [13]. A test instrument is considered valid if it can measure what it is intended to measure. An instrument used for research must have qualitative validity, meaning the instrument is designed to accurately reflect the research objectives and the research problem [14]. An instrument or measuring tool that has a level of validity must not only be able to produce precise or accurate data, but must also be able to provide a clear picture of the data produced, even in very detailed details between one and another [15]. The purpose of the validation test is to obtain a valid rating from experts and to determine the instrument's feasibility and quality. The validation process will produce learning media that demonstrates validity, as evidenced by the average percentage of validators who assessed it [16]. Validation test data is obtained from data instruments completed by experts or validators with expertise in their fields. Input provided by the validators can be used to improve the learning media to be used [17]. The validation process for learning media as a research instrument is carried out by validation experts from both material and learning media [18]. Validation by material experts aims to determine the validity of the material in terms of both content and content. The validation process by media experts is carried out to determine the validity of the learning media to be used in terms of appearance and media program [19].

Teachers must consider several factors before using learning media that will be used in the learning process in the classroom, one of which is the practicality factor [20]. The practicality factors that are measured include media displays that are attractive, fun, interactive, and can make it easier to understand the material presented in the media [21]. The effectiveness of learning media use must also be considered. This is intended to ensure that the teacher's delivery is understandable, thereby improving student learning outcomes. The effectiveness of learning media used must also be long-term and not just a one-time use [22]. The benchmark for measuring the effectiveness of learning media used in the learning process is to determine whether it supports the achievement of the established learning objectives [23]. This effectiveness can be measured by giving students assignments, exams, or projects to determine their understanding of the learning material taught through the media [24].

Students' skills and potential as the nation's next generation need to be developed through education, acquired through learning at school [25]. The learning process itself concludes with an assessment that demonstrates the learning outcomes of the students who participated in the course. The achievements or accomplishments of someone who has participated in a course or education are the very definition of learning outcomes [26]. Teachers, who play a crucial role as educators in teaching, must pay close attention to factors that can influence student learning outcomes. Teachers must understand what can influence student learning outcomes [27]. Learning conditions influence learning outcomes. If learning conditions feel boring and lack variety, it will cause students to become bored, thus preventing them from fully absorbing the material, leading to decreased learning outcomes [28].

One measure of the success of the learning process is the students' learning outcomes. Learning outcomes encompass several domains or aspects, namely the cognitive, affective, and psychomotor domains [29]. Learning success can be seen from changes in student behavior and learning outcomes [30]. Learning activities will proceed smoothly if students are motivated to learn [31]. Motivation can be defined as the driving

force within students that guides learning activities, ensures the continuity of the learning process, and provides guidance throughout the learning process so that learning objectives can be achieved [32].

70% of student learning outcomes are influenced by their own abilities, and 30% by the learning environment. Motivation, interest, attention, attitude, physical and psychological well-being are other factors that students possess that can influence learning outcomes. Learning conditions also influence learning outcomes. If learning conditions feel boring and lack variety, it will cause students to feel bored, thus preventing them from fully absorbing the material, leading to decreased learning outcomes. Students who have difficulty remembering or understanding the material presented by the teacher during the learning process will certainly achieve less than satisfactory learning outcomes. An example of visual learning media that is highly favored by students is learning with comics. Previous research has shown that the majority of students expressed a high level of interest in learning using comics [33].

Reading science comics is one way to acquire scientific knowledge in learning [34]. Beyond entertainment, manga now plays a unique role in both formal and informal education due to its ability to engage, enhance literacy, and encourage critical thinking. Recent research has shown that manga is effective in teaching values, science, and even language. Previous research has shown that most students have positive responses and attitudes toward the comics they read. Students tend to prefer comics over text when learning science. Science comics have a correlation between text type and students' attitudes and learning motivation [35]. One type of comic, called super deformed manga, abbreviated as elementary school, is a comic with a specific Japanese drawing style. Super deformed manga features characters depicted as small, slightly chubby, and short, with large heads. This depiction is intended to convey a humorous and cute impression. Super deformed manga can be an effective learning option, ensuring that the material presented is well-received by students [36].

Based on the description presented previously, this study has several objectives including to examine the validation of the digital super deformed manga comic development media, the practicality of the digital super deformed manga comic development media, and the effectiveness of the development media carried out through tests to determine the improvement in learning outcomes and learning motivation of students in science learning on the Earth and Solar System material after participating in learning with the developed digital super deformed manga comic media.

2. RESEARCH METHOD

The research used is the type of Research and Development (R&D) development research which provides validation of the products produced which will be used in the learning process. The development model used in this research is the 4D development model. The 4D development model is considered simpler than other development models, although it still requires careful planning and development [37]. The 4D development model consists of four stages, namely the define stage, the design stage, the development stage, and the disseminate stage. This research was conducted at three schools: Islamic junior high school Nurul Fata Lumutan Bondowoso, Islamic junior high school Bahrul Ulum Tangsil Kulon Bondowoso, and Islamic junior high school Nurul Ulum Cindogo Bondowoso in the odd semester of the 2025/2026 academic year. Learning will be conducted face-to-face. Sampling was done using random sampling techniques to determine the classes from each school that would be used as subjects in this development research.

The research conducted used techniques and several instruments in collecting data, including tests used to determine the understanding and mastery of science material presented in the development product, questionnaires that function to test the developed product and determine students' responses to the product, documentation that functions as evidence of the implementation of the research and obtains valid data to determine students' abilities, observations conducted to find out information about the school that will be used as the research site, and interviews aimed at obtaining data and information related to the learning process at the school that will be used as the research site.

Data analysis in this study consists of validity analysis, practicality analysis, and effectiveness analysis. The media development procedure includes the definition stage, consisting of initial analysis and needs analysis activities; the design stage, carried out to assist researchers in developing the product to be developed; the development stage, the stage carried out to realize the design that has been made so that it becomes a usable product; and distribution, which aims to promote the product resulting from the development so that it is accepted by users [38]. The product development will be validated by three expert validators in their respective fields, consisting of lecturers from the Science Education study program, FKIP, University of Jember. The validity analysis assessment rubric is attached in the appendix. In analyzing the validity assessment data, the quantitative data obtained through the validation questionnaire is analyzed by calculating the total score obtained, then calculating the percentage value using the following formula:

$$Validity\ value = \frac{Total\ score\ obtained}{Highest\ score} \times 100\% \ \dots \ (1)$$

The score achievement in percentage is then converted into qualitative form by referring to the validity categories listed in table 1 [39].

Table 1. Validity Category

Achievement Rate (%)	Category	Criteria
81-100	Very Valid	Very Good To Use
61-80	Valid	Can Be Used After Minor Revision
41-60	Valid Enough	Can Be Used After Major Revision
21-40	Invalid	Cannot Be Used
0-20	Very Invalid	Cannot Be Used

The results of observations conducted by observers can be used to analyze practicality. Science learning using the Super Deformed manga comic is considered practical if the score or value obtained from the implementation sheet indicates the practical or very practical category. The assessment rubric for the practicality analysis is attached in the appendix. The data obtained is then entered using the following formula:

$$Practicality\ value = \frac{Total\ score\ obtained}{Highest\ score} \times 100\% \ldots (2)$$

After obtaining the percentage, the results of the practicality analysis were then categorized based on the questionnaire score criteria table in table 2 [40].

Table 2. Practicality Category

Presentation	Category
$P \geq 100$	Very practical
$80 \leq P < 90$	Practical
$70 \leq P < 80$	Quite practical
$60 \leq P < 70$	Not practical
$P < 60$	Very not practical

Effectiveness analysis was conducted by analyzing learning outcomes and student responses. The N-Gain method was used to measure learning outcomes. The N-Gain formula for measuring learning outcomes was used to determine the improvement in learning outcomes [41].

$$N - Gain\ score = \frac{Posttest\ score - pretest\ score}{Ideal\ score - pretest\ score} \ldots (3)$$

Table 3. N-Gain Category

Score	Category
N-Gain ≥ 0.7	High
$0.3 \leq$ N-Gain < 0.7	Medium
N-Gain < 0.3	Low

The effectiveness analysis of the digital super deformed manga comic media was also conducted by analyzing student responses to the use of the media in learning. Student responses were measured through a response questionnaire regarding the digital super deformed manga comic learning media. The guidelines for analyzing student responses used in this questionnaire used a Likert Scale. The one-time guidelines used can be seen in table 4 [42].

Table 4. Assessment Score Guidelines

Score	Category
5	Strongly Agree
4	Agree
3	Disagree
2	Do Not Agree
1	Very Do Not Agree

A response questionnaire was administered after the treatment using the digital super deformed manga comic media. The percentage of student responses was calculated using the formula below, complete with student response criteria [42].

$$Percentage\ of\ student\ responses = \frac{The\ total\ number\ of\ respondents'\ answers}{Total\ ideal\ score} \times 100\% \dots (4)$$

Table 5. Student Response Criteria

Student Response Interval	Category
80% ≤ Na < 100%	Very Positive
60% ≤ Na < 80%	Positive
40% ≤ Na < 60%	Quite Positive
20% ≤ Na < 40%	Not Positive
Na < 20%	Very Not Positive

3. RESULTS AND DISCUSSION

The discussion consists of three topics, namely the validity, practicality, and effectiveness of the digital super deformed manga comic media developed in science learning on the Earth and Solar System material for junior high school students in improving learning outcomes and student motivation. The discussion is explained based on data obtained from the results of research that has been conducted and the results of research conducted by previous researchers.

3.1. Validity of Super Deformed Digital Manga Comic Media

The validation process was carried out on the product development, a digital super deformed manga comic media on the Earth and Solar System topic. Validation was conducted by three expert validators in the field of science learning, consisting of three lecturers from the Science Education study program, Faculty of Teacher Training and Education, University of Jember. The validity of the digital super deformed manga comic media was obtained through a validation process carried out by the validators on a product validation sheet. The product validation sheet consisted of six content validation aspects and nine construct validation aspects [43]. In development research, content validation involves verifying the suitability of concepts, definitions, borrowed materials, and presented images. Furthermore, the notation and text must be closely related to the concepts to avoid student misunderstandings during the learning process. The material contained in the product being developed must also be appropriate for the level of the students selected as research subjects [44].

The validation results of the digital super deformed manga comic media conducted by the lecturers showed very good results. Validator 1 gave a score of 51 out of 60 and an average value of 85. Validator 2 gave a total score of 53 out of 60 and an average value of 88. Validator 3 gave a total score of 57 out of 60 and an average value of 95. Validator 4 gave a total score of 59 out of 60 and an average of 98. The average of all validation results by the validators is that it meets the very valid criteria with a value of 91.5 based on calculations in the formula explained previously. So it can be concluded that the digital super deformed manga comic media is very valid and can be used.

In the data analysis contained in the research method, there are several categories of validator assessments that serve as a reference for the validity of the developed media. A range of 0 to 20 is categorized as very invalid and cannot be used. A range of 21 to 40 is categorized as invalid and cannot be used. A range of 41 to 60 can be categorized as quite valid, can be used after many revisions. A range of 61 to 80 can be categorized as valid, can be used after minor improvements. A range of 81 to 100 is categorized as very valid and can be used immediately [45]. The results of the comic media validation that have been carried out are very much in accordance with the previous research conducted by Fajriati and Putra (2022), where in that study the validated comics had a value range of 81-100 and were categorized as very valid.
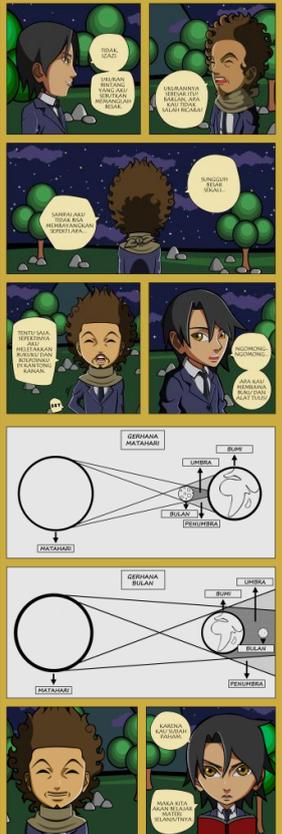
Table 6. Validation Results by Validator

Validators	Number of Values	Percentage	Category
1	51	92.72	Very Valid
2	53	96.36	Very Valid
3	59	98.33	Very Valid

The validators also provided several suggestions and input to improve the developed media. This validation assessment aligns with previous research, where validated media with a score range of 81-100 can be categorized as very high or very valid [45]. Similarly, the scoring system scores 1 indicate strongly disagree, 2 indicate agree, 3 indicate agree, and 4 indicate strongly agree [45]. Some improvements that have been made

based on suggestions and input from validators include comics must have a page or sheet that explains how to read the comic in the correct order, comics must have a page that shows the learning objectives of the material contained in the comic, pages that show the cognitive domain of evaluating (C5) must have a clearer context, and pages that show the cognitive domain of creating (C6) must have a clearer context.

Table 7. Correction by Validator

Before	Suggestions and Feedback	After
	Pages that show the cognitive domain of evaluating (C5) should have their context clarified. The page that shows the cognitive domain of creating (C6) must have its context clarified.	

3.2. The Practicality of Super Deformed Digital Manga Comic Media

Practicality of media is very necessary in learning [46]. The practicality of the developed digital super deformed manga comic media was obtained through observations of the implementation of learning by observers. If the results of the practicality test of the comic media are not declared practical, then revisions or improvements are needed to the comic media so that it can be declared practical. The implementation of learning using digital super deformed manga comic media was observed by observers. Observers wrote down the appropriate score from the Likert Scale on the observer sheet. In addition, observers could also provide input and suggestions on the developed media. The use of interactive and collaborative learning media can improve students' academic achievement by providing numerous meaningful and practical learning opportunities. Knowledge formation and knowledge exchange can go hand in hand. Therefore, the use of practical learning media is essential in the learning process [47].

The practicality of the digital super deformed manga comic media at the development stage was obtained through a small-scale limited trial. At the small-scale limited trial stage, the results of observations of the implementation of learning using the digital super deformed manga comic media showed a fairly good score. The small-scale limited trial was conducted in three meetings. At the first meeting, the practicality assessment score by the observer was 36 out of 40. At the second meeting, the practicality assessment score by the observer was 37 out of 40. The third and fourth meetings obtained a score of 36 out of 40. The average value of the results of the practicality assessment conducted by the observer in the small-scale limited trial was 90.6 with practical criteria.

Table 8. Limited Trial Practicality Assessment

Maximum Score	Practicality Assessment Sheet Results				Score (%)
	1st meeting	2nd meeting	3rd meeting	4th meeting	
40	36	37	36	36	90.6

The observation assessment results by observers from Islamic junior high school Bahrul Ulum showed an average of 91.875, thus categorized as very practical. The observation assessment results by observers from Islamic junior high school Nurul Fata showed an average of 90.655, thus categorized as very practical. The observation assessment results by observers from Islamic junior high school Nurul Ulum showed an average of 92.5, thus categorized as very practical. In research conducted by Umar (2023), it was stated that learning using comic media can be said to be very practical with an average practicality assessment above 80. In this study, the media developed also had an average value above 80, so the media was also categorized as very practical. Practical comic learning media is used in the learning process [48].

Table 9. Practical Results of Comic Media

Practicality	Islamic junior high school Bahrul Ulum	Islamic junior high school Nurul Fata	Islamic junior high school Nurul Ulum
▪ 1st meeting	97.5	90	92.5
▪ 2nd meeting	90	92.5	92.5
▪ 3nd meeting	90	90	92.5
▪ 4th meeting	90	90	92.5
Average	91.875	90.625	92.5
Category	Very Practical	Very Practical	Very Practical

3.3. The Effectiveness of Super Deformed Digital Manga Comic Media

The effectiveness of the digital super deformed manga comic learning media was obtained during the development and dissemination stages. The effectiveness of the learning media used in the learning process can be measured by the achievement of the predetermined learning objectives. The effectiveness of this digital super deformed manga comic media was measured through pre-tests and post-tests to assess learning outcomes and student responses, as well as through a questionnaire. During the development stage, random sampling was used [49]. The results of the pre-test and post-test from the limited, small-scale trial are shown in the table 10.

Table 10. Effectiveness Results on Limited Trial Learning Outcomes

Learning outcomes	Score	Category
Solar System		
▪ *Pre-Test*	35	Low
▪ *Post-Test*	64	Medium
▪ N-Gain	0.52	Medium
Moon and Eclipse		
▪ *Pre-Test*	19.5	Low
▪ *Post-Test*	66.5	Medium
▪ N-Gain	0.60	Medium
Earth Conditions		
▪ *Pre-Test*	5	Low
▪ *Post-Test*	59	Medium
▪ N-Gain	0.57	Medium
Earth and the Solar System		
▪ *Pre-Test*	32	Low
▪ *Post-Test*	63.5	Medium
▪ N-Gain	0.47	Medium

Based on the table above, it can be seen that in the first sub-material, namely the Sistem Tata Surya, the average pretest score is 35 with a low category, the average post-test score is 64 with a medium category, while the N-Gain score is 0.52 with a medium category. In the second sub-material, namely the Bulan dan Gerhana, the average pretest score is 19.5 with a low category, the average post-test score is 66.5 with a medium category, and the N-Gain score is 0.60 with a medium category. In the third sub-material, namely the Kondisi Bumi, the average pretest score is 5 with a low category, the average post-test score is 59 with a medium category, and the N-Gain score is 0.57 with a medium category. In the fourth sub-material, namely the Bumi dan Tata Surya, the average pretest score is 32 with a low category, the average post-test score is 63.5 with a medium category, and the N-Gain score is 0.47 with a medium category. This N-Gain score shows an increase in student learning outcomes after learning with digital super deformed manga comic media.

In the dissemination stage, the effectiveness of the digital super deformed manga comic media in determining learning outcomes was carried out in classes at three different schools, namely Islamic junior high school Bahrul Ulum, Islamic junior high school Nurul Fata, and Islamic junior high school Nurul Ulum, each located in Bondowoso Regency. The learning outcomes at the dissemination stage can be seen in the table 11.

Table 11. Learning Outcomes of the Dissemination Stage

Learning Outcomes	Islamic junior high school Bahrul Ulum	Islamic junior high school Nurul Fata	Islamic junior high school Nurul Ulum
Solar System			
▪ *Pre-Test*	42.3	29	32.6
▪ *Post-Test*	78.8	84	77.9
N-Gain	0.60	0.76	0.71
Category	Medium	High	High
Moon and Eclipse			
▪ *Pre-Test*	47.3	25	27.3
▪ *Post-Test*	82.3	76.5	64.7
N-Gain	0.60	0.70	0.57
Category	Medium	High	Medium
Earth Conditions			
▪ *Pre-Test*	41.9	6.5	8.9
▪ *Post-Test*	82.3	60.5	67.9
N-Gain	0.68	0.58	0.65
Category	Medium	Medium	Medium
Earth and the Solar System			
▪ *Pre-Test*	38	25.5	28.9
▪ *Post-Test*	87.7	75.5	78.4
N-Gain	0.81	0.63	0.69
Category	Medium	Medium	Medium

Effectiveness tests conducted at three schools showed an increase in student learning outcomes. The improvement in learning outcomes varied across schools. The learning outcomes of Islamic junior high school Bahrul Ulum students have increased after learning using super deformed digital manga comic media. In the Solar System sub-material, the average pre-test score was 42.3 and experienced an increase in the average post-test score to 78.8 with an N-Gain value of 0.60 which can be categorized as moderate. In the second sub-material, namely the Moon and Eclipse, the average pre-test score was 47.3 and experienced an increase in the average post-test score to 82.3 with an N-Gain value of 0.60 which can be categorized as moderate. In the third sub-material, namely the Condition of the Earth, the average pre-test score was 41.9 and experienced an increase in the average post-test score to 82.3 with an N-Gain value of 0.68 which can be categorized as moderate. In the fourth sub-material, namely Earth and the Solar System, the average pre-test score was 38 and experienced an increase in the average post-test score to 87.7 with an N-Gain value of 0.81 which can be categorized as high.

The learning outcomes of Islamic junior high school Nurul Fata students also increased after learning using super deformed digital manga comic media. In the Solar System sub-material, the average pre-test score was 29 and increased in the average post-test score to 84 with an N-Gain value of 0.76 which can be categorized as high. In the second sub-material, namely the Moon and Eclipse, the average pre-test score was 25 and increased in the average post-test score to 76.5 with an N-Gain value of 0.70 which can be categorized as high. In the third sub-material, namely the Condition of the Earth, the average pre-test score was 6.5 and increased in the average post-test score to 60.5 with an N-Gain value of 0.58 which can be categorized as moderate. In the fourth sub-material, namely the Earth and the Solar System, the average pre-test score was 25.5 and experienced an increase in the average post-test score to 75.5 with an N-Gain value of 0.63 which can be categorized as moderate.

The learning outcomes of Islamic junior high school Nurul Ulum students also increased after learning using super deformed digital manga comic media. In the Solar System sub-material, the average pre-test score was 32.6 and increased in the average post-test score to 77.9 with an N-Gain value of 0.71 which can be categorized as high. In the second sub-material, namely the Moon and Eclipse, the average pre-test score was 27.3 and increased in the average post-test score to 64.7 with an N-Gain value of 0.57 which can be categorized as moderate. In the third sub-material, namely the Condition of the Earth, the average pre-test score was 8.9 and increased in the average post-test score to 67.9 with an N-Gain value of 0.65 which can be categorized as moderate. In the fourth sub-material, namely the Earth and the Solar System, the average pre-test score was 28.9 and experienced an increase in the average post-test score to 78.4 with an N-Gain value of 0.69 which can be categorized as moderate.

The average learning outcomes at Islamic junior high school Bahrul Ulum consistently improved at each meeting. Based on the table above, the improvement in learning outcomes indicates that the digital super deformed manga comic media is effective for use in learning. Previous research has shown that the use of digital

comic media is very effective in improving student learning outcomes and interest in learning in the classroom. As a learning medium, comics are effective in improving student learning outcomes [50]. The second effectiveness test is to analyze student learning motivation. The results of student responses at the small-scale limited trial stage are shown in the table 12.

Table 12. Average Limited Trial Student Response Results

1st meeting	2nd meeting	3rd meeting	4th meeting
74.5	75.5	75.1	75.1

The results of student responses in the limited trial shown in the table have an average value of 74.5 in the first meeting, 75.5 in the second meeting, 75.1 in the third and fourth meetings. Then the results of student responses in the limited trial conducted in four meetings show that student responses are at an average value of 75.05 with positive criteria. This assessment criteria is in accordance with previous research, where the range of $81\% < P \le 100\%$ is categorized as very positive, $61\% < P \le 81\%$ is categorized as positive, $41\% < P \le 61\%$ is categorized as sufficient, $21\% < P \le 41\%$ is categorized as less positive, and $0\% < P \le 21\%$ is categorized as very less positive. Student response analysis was also conducted during the dissemination phase. Guidelines for analyzing student responses to determine learning motivation in participating in learning using the digital Super Deformed Manga comic media can be seen in the table 13.

Table 13. Student Response Results in the Dissemination Stage

No.	Material	Average score		
		Islamic junior high school Bahrul Ulum	Islamic junior high school Nurul Fata	Islamic junior high school Nurul Ulum
1.	Solar System	88.20	78.60	89.64
2.	Moon and Eclipse	85.12	75.50	84.91
3.	Earth Conditions	91.02	78.30	86.84
4.	Earth and the Solar System	88.07	78.60	89.64
	Average	88,10	77.75	87.77
	Category	Very positive	Positive	Very positive

The results of student responses at the dissemination stage through a questionnaire given after the implementation of learning using digital super deformed manga comic media at Islamic junior high school Bahrul Ulum showed very positive results. At the first meeting of the Solar System sub-material, the average value of student responses was 88.20 with very positive criteria. At the second meeting of the Moon and Eclipse sub-material, the average value of student responses was 85.12 with very positive criteria. At the third meeting of the Earth Condition sub-material, the average value of student responses was 91.02 with very positive criteria. And at the fourth meeting of the Earth and Solar System sub-material, the average value of student responses was 88.07 with very positive criteria. The average value of student responses from the first meeting to the fourth meeting was 88.10 and can be categorized as very positive.

The results of student responses at the dissemination stage through a questionnaire given after the implementation of learning using digital super deformed manga comic media at Islamic junior high school Nurul Fata also showed very positive results. At the first meeting of the Solar System sub-material, the average value of student responses was 78.60 with positive criteria. At the second meeting of the Moon and Eclipse sub-material, the average value of student responses was 75.70 with positive criteria. At the third meeting of the Earth Condition sub-material, the average value of student responses was 78.30 with positive criteria. And at the fourth meeting of the Earth and Solar System sub-material, the average value of student responses was 78.60 with positive criteria. The average value of student responses from the first meeting to the fourth meeting was 77.75 and can be categorized as positive.

The results of student responses at Islamic junior high school Nurul Ulum at the dissemination stage through a questionnaire given after the implementation of learning using digital super deformed manga comic media showed very positive results. At the first meeting of the Solar System sub-material, the average value of student responses was 89.64 with very positive criteria. At the second meeting of the Moon and Eclipse sub-material, the average value of student responses was 84.91 with very positive criteria. At the third meeting of the Earth Condition sub-material, the average value of student responses was 86.84 with very positive criteria. And at the fourth meeting of the Earth and Solar System sub-material, the average value of student responses was 89.64 with very positive criteria. The average value of student responses from the first meeting to the fourth meeting was 87.77 and can be categorized as very positive.

The results of student responses at the dissemination stage through a questionnaire given after learning using digital super deformed manga comic media showed high student learning motivation. The level of learning motivation in each school varies. Student learning motivation from Islamic junior high school Bahrul Ulum has

the highest category. The overall effectiveness test of learning outcomes and learning motivation at this dissemination stage showed that digital super deformed manga comic media is effective for use in science learning on the Earth and Solar System material, especially to improve student learning outcomes and learning motivation.

Some obstacles in this study were that there were several students who did not have internet data packages to download the digital super deformed manga comics that had been distributed via WhatsApp, efforts were made to anticipate this by using the researcher's hotspot. In addition, there were several students who brought cellphones, so they had to borrow the researcher's and observer's cellphones. During the learning process, some students did not read the comics that had been sent via WhatsApp, but instead opened social media applications such as Tik Tok, Instagram, or replied to messages on WhatsApp, thus disrupting the learning process using the digital super deformed manga comic media.

4. CONCLUSION

The digital super deformed manga comic learning media on the Earth and Solar System material is categorized as valid in improving the learning fate and learning motivation of junior high school students after being validated by three validators. This digital super deformed manga comic media also has a high level of practicality, so it can be stated as practical in improving learning outcomes and student learning motivation. In the effectiveness test, this digital super deformed manga comic media has an influence on improving learning outcomes, and shows high student learning motivation after participating in learning using this comic.

AUTHOR CONTRIBUTIONS

Muhammad Fahmi Alfarisi was responsible for the research design, data collection, data analysis, and manuscript preparation. I Ketut Mahardika, the first supervisor, and Erlia Narulita contributed to the conceptual development, research methodology guidance, and revisions to improve the quality and clarity of the manuscript. All authors have read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

REFERENCES

[1] H. Harosid, "Utilization of audio visual media to improve motivation and learning outcomes in natural sciences," *Sci. Educ. J.*, vol. 1, no. 6, pp. 1–9, 2025, doi: 10.62872/ekhgtt54.

[2] A. Asmaldi, I. Husti, and Z. Zamsiswaya, "Integration between religion and science in islamic studies in integrated islamic junior high school," *Khalifa J. Islam. Educ.*, vol. 6, no. 2, p. 240, 2022, doi: 10.24036/kjie.v6i2.274.

[3] J. I. Chisunum and C. N. Nwadiokwu, "Enhancing student engagement through practical production and utilization of instructional materials in an educational technology class: A multifaceted approach," *NIU J. Educ. Res.*, vol. 10, no. 2, pp. 81–89, 2024, doi: 10.58709/niujed.v10i2.2002.

[4] I. M. Sutama, I. N. Yasa, I. P. M. Dewantara, and K. Saddhono, "ICT Utilization in Indonesian language learning at the junior high school level in Buleleng Regency, Bali, Indonesia," *Int. J. Inf. Educ. Technol.*, vol. 12, no. 9, pp. 947–955, 2022, doi: 10.18178/ijiet.2022.12.9.1705.

[5] I. Khadijah, N. Nurhamidah, L. Mulyani, S. N. Amanah, and N. Sukmanawati, "Improving learning outcomes through innovative pedagogical approaches in modern education," *J. English Lang. Educ.*, vol. 10, no. 1, pp. 423–433, 2025, doi: 10.31004/jele.v10i1.661.

[6] B. Katona, J. Venkataragavan, E. Nina, B. Ulrika, and O. Björn, "Use of visual learning media to increase student learning motivation," *World Psychol.*, vol. 1, no. 3, pp. 89–105, 2023, doi: 10.55849/wp.v1i3.381.

[7] M. Ritonga, S. R. Febriani, M. Kustati, E. Khaef, A. W. Ritonga, and R. Yasmar, "Duolingo: An arabic speaking skills' learning platform for andragogy education," *Educ. Res. Int.*, vol. 2022, 2022, doi: 10.1155/2022/7090752.

[8] P. Puhka, B. Annemari, and R. Harry, "Application of learning media and technology in schools to increase student

interest in learning," *World Psychol.*, vol. 1, no. 3, pp. 160–176, 2023, doi: 10.55849/wp.v1i3.387.

[9]   S. Md Sabri, I. Ismail, N. Annuar, N. R. Abdul Rahman, N. Z. Abd Hamid, and H. Abd Mutalib, "A conceptual analysis of technology integration in classroom instruction towards enhancing student engagement and learning outcomes," *Int. J. Educ. Psychol. Couns.*, vol. 9, no. 55, pp. 750–769, 2024, doi: 10.35631/ijepc.955051.

[10]   T. Tanti, W. Utami, D. Deliza, and M. Jahanifar, "Investigation in vocation high school for attitude and motivation students in learning physics subject", *Journal Evaluation in Education (JEE)*, vol. 6, no. 2, pp. 479-490, 2025, doi: 10.37251/jee.v6i2.1452.

[11]   O. Kuchai *et al.*, "Possibilities of using multimedia technologies in education," *IJCSNS Int. J. Comput. Sci. Netw. Secur.*, vol. 22, no. 6, p. 727, 2022, doi: 10.22937/IJCSNS.2022.22.6.91

[12]   L. Hasanah Lubis, B. Febriani, R. Fitra Yana, A. Azhar, and M. Darajat, "The use of learning media and its effect on improving the quality of student learning outcomes," *Int. J. Educ. Soc. Stud. Manag.*, vol. 3, no. 2, pp. 7–14, 2023, doi: 10.52121/ijessm.v3i2.148.

[13]   S. C. Izah, L. Sylva, and M. Hait, "Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment," *ES Energy Environ.*, vol. 23, pp. 1–14, 2024, doi: 10.30919/esee1057.

[14]   W. M. Lim, "A typology of validity: content, face, convergent, discriminant, nomological and predictive validity," *J. Trade Sci.*, vol. 12, no. 3, pp. 155–179, 2024, doi: 10.1108/jts-03-2024-0016.

[15]   N. W. Raharjanti *et al.*, "Translation, validity and reliability of decision style scale in forensic psychiatric setting in Indonesia," *Heliyon*, vol. 8, no. 7, p. e09810, 2022, doi: 10.1016/j.heliyon.2022.e09810.

[16]   T. Tanti, A. Astalini, D. A. Kurniawan, D. Darmaji, T. O. Puspitasari, and I. Wardhana, "Attitude for physics: The condition of high school students," *Jurnal Pendidikan Fisika Indonesia*, vol. 17, no. 2, pp. 126-132, 2021, doi: 10.15294/jpfi.v17i2.18919.

[17]   P. Cruchinho *et al.*, "Translation, cross-cultural adaptation, and validation of measurement instruments: A practical guideline for novice researchers," *J. Multidiscip. Healthc.*, vol. 17, pp. 2701–2728, 2024, doi: 10.2147/JMDH.S419714.

[18]   M. P. Pratama, S. Ruruk, and P. Karuru, "Validity of interactive learning media in computer basics course," *J. Inov. Teknol. Pendidik.*, vol. 10, no. 4, pp. 353–362, 2023, doi: 10.21831/jitp.v10i4.60376.

[19]   H. Aksah, A. I. Che Ani, S. Johar, and S. H. Husain, "Evaluating the content validity: Development of an instrument for measuring functional building performance," *Int. J. Glob. Optim. Its Appl.*, vol. 2, no. 1, pp. 12–19, 2023, doi: 10.56225/ijgoia.v2i1.161.

[20]   C. W. Hoerudin, S. Syafruddin, A. Mayasari, O. Arifudin, and S. Lestari, "E-Learning as a learning media innovation Islamic education," *QALAMUNA J. Pendidikan, Sos. dan Agama*, vol. 15, no. 1, pp. 723–734, 2023, doi: 10.37680/qalamuna.v15i1.4466.

[21]   A. Jannah, Irwandi, A. H. Lubis, and N. M. Julia, "Development of number card media in mathematics learning for elementary school students," *J. Indones. Prim. Sch.*, vol. 1, no. 3, pp. 12–23, 2024, doi: 10.62945/jips.v1i3.135.

[22]   Q. H. Tran-Duong, "The effect of media literacy on effective learning outcomes in online learning," *Educ. Inf. Technol.*, vol. 28, no. 3, pp. 3605–3624, 2023, doi: 10.1007/s10639-022-11313-z.

[23]   A. T. Devega, A. Ambiyar, P. Panyahuti, N. H. Adi, and A. R. Riyanda, "The effectiveness of learning media on the outcome of computer and basic network of vocational students," *J. Pendidik. Teknol. Kejuru.*, vol. 5, no. 2, pp. 47–52, 2022, doi: 10.24036/jptk.v5i2.23123.

[24]   I. S. Chaudhry, S. A. M. Sarwary, G. A. El Refae, and H. Chabchoub, "Time to revisit existing student's performance evaluation approach in higher education sector in a new era of chatgpt-a case study," *Cogent Educ.*, vol. 10, no. 1, 2023, doi: 10.1080/2331186X.2023.2210461.

[25]   M. B. Purwanto, R. Hartono, and S. Wahyuni, "Essential skills challenges for the 21st century graduates: Creating a generation of high-level competence in the industrial revolution 4.0 era," *Asian J. Appl. Educ.*, vol. 2, no. 3, pp. 279–292, 2023, doi: 10.55927/ajae.v2i3.3972.

[26]   T. Tanti, A. Astalini, D. Darmaji, D. A. Kurniawan, and R. Fitriani, "Student perception review from gender: Electronic moduls of mathematical physics," *JPI (Jurnal Pendidikan Indonesia)*, vol. 11, no. 1, pp. 125-132, 2022, doi: 10.23887/jpiundiksha.v11i1.35107.

[27]   K. W. K. Lo, G. Ngai, S. C. F. Chan, and K. P. Kwan, "How students' motivation and learning experience affect their service-learning outcomes: A structural equation modeling analysis," *Front. Psychol.*, vol. 13, no. April, pp. 1–12, 2022, doi: 10.3389/fpsyg.2022.825902.

[28]   R. Mursid, A. H. Saragih, and R. Hartono, "The effect of the blended project-based learning model and creative thinking ability on engineering students' learning outcomes," *Int. J. Educ. Math. Sci. Technol.*, vol. 10, no. 1, pp. 218–235, 2022, doi: 10.46328/ijemst.2244.

[29]   M. A. Alafnan, "Enhancing educational outcomes using AlAfnan taxonomy: Integrating cognitive, affective, and psychomotor domains," *Int. J. Eval. Res. Educ.*, vol. 14, no. 3, pp. 2419–2437, 2025, doi: 10.11591/ijere.v14i3.33147.

[30]   L. Wang and L. Calvano, "Class size, student behaviors and educational outcomes," *Organ. Manag. J.*, vol. 19, no. 4, pp. 126–142, 2022, doi: 10.1108/OMJ-01-2021-1139.

[31]   S. Inganah, R. Darmayanti, and N. Rizki, "Problems, solutions, and expectations: 6c integration of 21 st century education into learning mathematics," *JEMS J. Edukasi Mat. dan Sains*, vol. 11, no. 1, pp. 220–238, 2023, doi: 10.25273/jems.v11i1.14646.

[32]   K. Karyaningsih, E. M. Solissa, E. Y. R. Pratiwi, D. Destari, and F. Meisarah, "Comparative study of the influence of student learning motivation on student learning outcomes in a view of gender in thematic subject," *Edunesia J. Ilm. Pendidik.*, vol. 4, no. 2, pp. 458–471, 2023, doi: 10.51276/edu.v4i2.378.

[33]   R. R. Rasmet, N. F. Shaafi, S. Sharif, S. Md. Nasir, M. F. Mat Salleh, and E. Ellianawati, "The impacts of comic-based learning on student engagement in primary education: A systematic literature review," *Citra J. Innov. Educ. Pract.*, vol. 1, no. 1, pp. 26–39, 2025, doi: 10.37934/cjiep.1.1.2639.

[34] Y. C. Jian, "Reading behavior in science comics and its relations with comprehension performance and reading attitudes: an eye-tracker study," *Res. Sci. Educ.*, vol. 53, no. 4, pp. 689–706, 2023, doi: 10.1007/s11165-022-10093-3.

[35] M. Şentürk, "The effect of educational comics and educational cartoons on students' attitude," *Int. J. Educ. Technol. Sci. Res.*, vol. 7, no. 17, pp. 378–413, 2022, doi: 10.35826/ijetsar.422.

[36] C. Sly, "Guide to a better understanding and appreciation of manga texts," *J. Educ.*, vol. 41, no. 1, pp. 12–20, 2022, doi: 10.3316/informit.292345651477476

[37] R. B. Indaryanti, H. Harsono, S. Sutama, B. Murtiyasa, and B. Soemardjoko, "4D research and development model: Trends, challenges, and opportunities review," *Jurnal Kajian Ilmiah*, vol. 25, no. 1, pp. 91-98, 2025, doi: 10.31599/na7deq07.

[38] I. Mulyati, I. Astuti, and E. Ernawaty, "Development of canva application assisted learning media in class xii advanced study materials with 4-d models," *JTP - J. Teknol. Pendidik.*, vol. 24, no. 3, pp. 322–329, 2022, doi: 10.21009/jtp.v24i3.30483.

[39] Y. Nofriza and Z. Zen, "Analysis validation and practicality of crossword puzzle learning media in science subjects for class vii in junior high schools," *J. Penelit. Pendidik. IPA*, vol. 10, no. 6, pp. 2891–2897, 2024, doi: 10.29303/jppipa.v10i6.7489.

[40] L. M. K. Amali, N. E. Ntobuo, R. Uloli, Y. Mohamad, and M. Yunus, "Development of magnetic digital comics in science learning to improve student learning outcomes in elementary schools," *J. Penelit. Pendidik. IPA*, vol. 9, no. 2, pp. 548–555, 2023, doi: 10.29303/jppipa.v9i2.2915.

[41] A. Triyono, R. H. Nuary, N. Permatasari, Y. Yuni, and T. Wibowo, "The level of effectiveness of TPS and conventional methods judging from students' geometry learning results using the n-gain test," *AlphaMath J. Math. Educ.*, vol. 10, no. 1, p. 125, 2024, doi: 10.30595/alphamath.v10i1.21530.

[42] A. Ramadhani, I. Ismet, and K. Wiyono, "Solar system learning innovation through augmented reality: Increasing student concept solar system," *Integrated Science Education Journal*, vol. 7, no. 1, pp. 01-09, 2026, doi: 10.37251/isej.v7i1.2443.

[43] M. Fahrurrozi and M. Mohzana, "Adobe flash based learning media development in economic lessons," *J. Educ. J. Pendidik. Indones.*, vol. 8, no. 2, p. 83, 2022, doi: 10.29210/1202222432.

[44] A. Roebianto, S. I. Savitri, I. Aulia, A. Suciyana, and L. Mubarokah, "Content validity: Definition and procedure of content validation in psychological research," *TPM - Testing, Psychom. Methodol. Appl. Psychol.*, vol. 30, no. 1, pp. 5–18, 2023, doi: 10.4473/TPM30.1.1.

[45] D. Y. Fajriati and A. Putra, "Validity and practicality of animation video-based learning media on various forces and inertial properties of objects," *Phys. Learn. Educ.*, vol. 1, no. 3, pp. 137–145, 2023, doi: 10.24036/ple.v1i3.74.

[46] D. Ji, X. Wang, and T. Zhang, "Application of new media in student management from the perspective of deep learning and evaluation and analysis of practical effects," *Comput. Math. Methods Med.*, vol. 2022, 2022, doi: 10.1155/2022/1765448.

[47] A. Sivakumar, S. Jayasingh, and S. Shaik, "Social media influence on students' knowledge sharing and learning: an empirical study," *Educ. Sci.*, vol. 13, no. 7, 2023, doi: 10.3390/educsci13070745.

[48] R. Darmayanti, R. Sugianto, B. Baiduri, C. Choirudin, and W. Wawan, "Digital comic learning media based on character values on students' critical thinking in solving mathematical problems in terms of learning styles," *Al-Jabar J. Pendidik. Mat.*, vol. 13, no. 1, pp. 49–66, 2022, doi: 10.24042/ajpm.v13i1.11680.

[49] T. Kida and G. Chiba, "Enhancement of applicability of high-efficiency random sampling method using control variates method and sensitivity coefficients," *J. Nucl. Sci. Technol.*, vol. 59, no. 7, pp. 866–874, 2022, doi: 10.1080/00223131.2021.2015473.

[50] H. P. Pamungkas, "Effectiveness of economic comics as a learning media on economic lesson," *AL-ISHLAH J. Pendidik.*, vol. 14, no. 3, pp. 3989–3994, 2022, doi: 10.35445/alishlah.v14i3.1675.